Procedure for Estimating Contingency
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This document gives the procedure for estimating contingencies on the MINERvA project. There are different procedures, depending on if the task is predominantly M&S or if it is Labor. The M&S contingency table is the one that has been adopted by BABAR The labor contingency tables have been developed by Bob Bradford and Deborah Harris.

The most important part of filling out these tables is that it forces you to think about the risks. If after filling out the table you get a contingency you are not comfortable with, simply include that in the BOE and provide the contingency you are comfortable with, and a justification (i.e. imagine you are constrained to hire a full extra person for the job if it takes more effort than expected: then the contingency would have to cover one extra person, not just a fraction of a person).

I. M&S Contingency

Factor (R)	Technical	Design	Cost	Schedule
0	Not used	Detailed design more than 50% complete	Not used	
1	Existing Design; off the shelf hardware	Not used	Off-the-shelf or catalog item	Not used
2	Minor modifications to an existing design	Not used	Vendor quote from established drawings	Not used
3	Extensive modifications to an existing design	Not used	Vendor quote with some design sketches	No schedule impact on any other item
4	New design; nothing exotic	Preliminary design more than 50% complete; some analysis done	In-house estimate based on previous experience	Not used
6	New design; different from established designs;existing technology	Not done	In-house estimate for item with minimal experience but related to existing capabilities	Delays completion of non-critical subsystem item
8	New design; requires some R&D, but does not advance the state of the art	Conceptual design phase; some drawings; many sketches	In-house estimate for item with minimal experience and minimal in-house capability	Delays completion of critical subsystem item
10	New design; development of new technology; advances state-of-the art	Not used	Top-down estimate from analogous programs	Not used
15	New design; well beyond current state-of-the-art	Concept only	Engineering judgment	Not used
Weight	**2%**	**2%**	**1%**	**1%**

Example: (yellow indicates calculated values)

Total Cost	Technical	Design	Cost	Schedule	Total	Cont
10000	4	15	4	8	0.5	$5,000

II.   Labor Contingency

Labor Contingency is evaluated differently, depending on if the task is to be performed once (like designing a detector stand), or if it is to be performed many times (like assembling a scintillator plane). In either case there are four categories that should be evaluated, and the contingency is again the sum of the Risk factor times the weight. The following two tables give the guidance for non-repetitive and repetitive tasks. A detailed explanation of the repetitive task categories follows the last table.

A. Labor Contingency Estimator: Non-repetitive Tasks

Factor (R)	Personnel Experience	Procedure Definition	Similarity to Prior Work	Task Duration
1	Experienced professional who has done this before	Design and procedures finalized	Identical work in the past at this institution	2 years
3	Experienced professional who hasn't done this before	Well-defined process	Identical work done at other institution	6 months
7	New professional	Some details understood	Similar work done at this facility	2 months
10	Undergraduate or graduate	Conceptual only	Similar work done at different facility	2 weeks
15	Summer student	None exists	None	Few days
Weight	2%	2%	1%	1%

$$\%C = \sum_i R_i W_i$$

Example: (yellow indicates calculated values)

Total Cost	Personnel Experience	Procedure Definition	Similarity to Prior Work	Task Duration	Total	Contingency
10000	4	15	4	3	0.45	$4,500

B. Labor Contingency Estimator: Repetitive Tasks

Factor	Startup	Duration Estimate	Reliance on Vendors	Task Duration
1	Task rehearsed; experienced crew	Estimate from similar experience	(1) Vendors reliable; (2) significant float before item(s) needed; (3) can easily find alternate vendor.	2 years
3	Minor recent changes to protocol; some new labor.	Estimate from related experience with minor differences.	Vendor reasonably reliable, but not replaceable. Reasonable float in schedule.	6 months
7	Significant changes to protocol or to labor	Estimate from experience with understood but significant differences.	Vendor reasonably reliable, but not replaceable. Not much float in schedule.	2 months
10	Significant changes to protocol and significant new hires.	Engineer's estimate	Vendors unreliable (task not prototyped); and not replaceable. Minimal schedule float.	2 weeks
15	Procedure unrehearsed; entirely new crew.	Physicist's estimate	Vendor unreliable (WBS task not prototyped); Minimal schedule float, item on/near critical path.	Few days
Weight	2	1	1	1

$$\% C = \sum_i R_i W_i$$

Example: (yellow indicates calculated values)

Total Cost	Startup	Duration Estimate	Reliance on Vendors	Task Duration	Total	Contingency
1000	4	15	4	3	0.3	$300

Repetitive Task Contingency Categories:

1. Startup: With repetitive tasks, delays are most likely related to an under-estimated startup time. It's always the first few units that will require the most time – building the first module or assembling the first PMT box. During startup, the labor are still familiarizing themselves with the production process, and they are relatively unskilled. By the time a few units has been produced, everyone is an expert, bugs in the production process have been addressed, and things should be moving along smoothly. Chances for contingency here are going to be related to the experience of the workforce and the procedural definition of the task. For example: How much of the your labor force was newly hired for the job? Did any of the workers help construct prototypes? How closely did the prototype resemble the final product? Have there been any significant changes in tooling or the production process since the prototyping effort?

2. Duration Estimate: This category deals with the rate of production after startup. Ideally, total durations for a long-term production process are based on some assumed rate (i.e. – assembling 5 PMT boxes per week, building 1 scintillator plane per day). This rate is scaled by the total number of deliverables to produce the total task duration. How certain are you of the rate? Did you estimate the rate from prototyping? If so, how realistic was the prototyping effort? Did you scale from MINOS? Is this an engineer's estimate? A physicist's estimate? Granted, the last two estimates are "rough": clearly not all physicists warrant the same contingency factor, nor do all engineers.

3. Reliance on vendors: Links to other WBS tasks (or vendors) pose risks to a schedule. For example, module assembly relies on delivery of steel frames from WBS8 and packaged scintillator from WBS3. Will a delay in shipment of a delivery impact your schedule? You might consider how reliable a vendor has been in the past, or how complex the component is you are receiving (Are you waiting on stock steel tubing, or is the deliverable more complex)? If there is a significant delay, can you find an alternate vendor? Also, what is the delivery schedule? If all shipments are to be received before you open your factory, then you minimize contingency due to a vendor delay. If the deliverables come in multiple shipments, with some shipments coming after your factory is running, then you risk having a cost contingency (standing army problem) in the event of a delay.

4. Duration of task: This is the length of your 85% CL task duration that goes into project. Longer tasks have more flexibility in overcoming vendor delays, bad startups, etc.